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Impact of augmented reality (AR) and virtual reality (VR) on online shopping experience

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Abstract

The rapid evolution of augmented reality (AR) and virtual reality (VR) technologies has fundamentally transformed the e-commerce landscape, bridging the experiential gap between physical and digital retail environments. This study examines the impact of AR and VR on online shopping experiences, focusing on consumer engagement, purchase confidence, and behavioral outcomes. Through a comprehensive review of recent literature and empirical data, the research explores how immersive technologies enhance product visualization, reduce return rates, and influence purchase decisions. The findings indicate that AR and VR significantly improve consumer satisfaction by enabling virtual try-ons, spatial product placement, and interactive experiences. Statistical evidence reveals that retailers implementing AR/VR solutions experience up to 94% higher conversion rates and 40% reduction in product returns. The study also addresses implementation challenges, including technological barriers, cost considerations, and privacy concerns. This research contributes to the growing body of knowledge on digital retail innovation and provides practical insights for businesses seeking to leverage immersive technologies for competitive advantage. The implications suggest that AR and VR are transitioning from optional enhancements to essential components of modern e-commerce strategy, particularly for engaging younger demographics who increasingly expect interactive shopping experiences.

Keywords: Augmented Reality, Virtual Reality, E-commerce, Consumer Behavior, Online Shopping, Digital Retail, Purchase Intention.

Introduction

Background and Context

The digital transformation of retail has accelerated dramatically in recent years, with e-commerce platforms continuously seeking innovative solutions to replicate and enhance the tactile, visual, and experiential aspects of traditional brick-and-mortar shopping (Garg et al., 2021). While online shopping offers unparalleled convenience and accessibility, it has historically suffered from a fundamental limitation: the inability of consumers to physically interact with products before purchase. This experiential gap has contributed to high return rates, purchase hesitation, and reduced consumer confidence in online transactions (Galappaththi et al., 2024).

Augmented reality and virtual reality technologies have emerged as transformative solutions to these longstanding challenges in online retail. AR enhances the real-world environment by overlaying digital information, allowing consumers to visualize products in their actual physical spaces or on their own bodies through smartphones or tablets (Baltierra, 2023). VR, conversely, creates fully immersive digital environments that simulate physical shopping experiences, enabling consumers to explore virtual stores and interact with products in three-dimensional spaces (Vineet et al., 2021).

The COVID-19 pandemic significantly accelerated the adoption of these immersive technologies as physical store closures forced both retailers and consumers to embrace digital channels (Gulati et al., 2021). What began as a necessity has evolved into a strategic imperative, with businesses recognizing that AR and VR offer not merely temporary solutions but fundamental improvements to the online shopping experience. Today's consumers, particularly younger demographics, increasingly expect interactive, personalized, and immersive digital experiences that traditional e-commerce platforms cannot provide (Shah & Shah, 2024).

Problem Statement

Despite the growing implementation of AR and VR in e-commerce, there

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remains a need for comprehensive understanding of how these technologies specifically impact consumer behavior, purchase decisions, and overall shopping satisfaction. While anecdotal evidence and individual case studies suggest positive outcomes, systematic examination of the mechanisms through which AR and VR influence online shopping experiences is essential for retailers considering substantial investments in these technologies. Furthermore, the challenges and barriers to widespread adoption—including technological limitations, implementation costs, and consumer acceptance—require thorough investigation to guide strategic decision-making in the retail sector.

Research Objectives

This study aims to:

1. Examine the impact of AR and VR technologies on consumer engagement and purchase behavior in online shopping environments
2. Analyze how immersive technologies influence purchase confidence, product visualization, and decision-making processes.
3. Evaluate the effectiveness of AR and VR in reducing product return rates and enhancing customer satisfaction.
4. Identify the key benefits and challenges associated with implementing AR and VR in e-commerce platforms.
5. Explore demographic variations in AR and VR adoption and usage patterns.
6. Provide evidence-based recommendations for retailers considering AR and VR integration.

Literature Review

Theoretical Foundations

The application of AR and VR in e-commerce is grounded in several established theories of consumer behavior and technology adoption. The Technology Acceptance Model (TAM) suggests that perceived usefulness and perceived ease of use are primary determinants of technology adoption (Engel et al., 1995). In the context of AR and VR shopping experiences, consumers must perceive these technologies as both beneficial to their shopping process and sufficiently intuitive to use without significant learning curves.

Telepresence theory provides another crucial framework for understanding AR and VR's impact on online shopping. Telepresence refers to the sense of "being there" in a mediated environment, which AR and VR technologies can create through high levels of interactivity and vividness (Díaz, 2022). This psychological state of presence enhances the realism of product experiences and more closely mimics physical shopping, thereby increasing consumer engagement and purchase intention.

AR and VR Applications in E-commerce

Contemporary AR and VR implementations in e-commerce span multiple categories and use cases. Virtual try-on solutions represent perhaps the most widespread application, allowing consumers to visualize how clothing, accessories, cosmetics, or

eyewear will appear on their own bodies without physical interaction (Enyejo et al., 2024). Leading brands such as Sephora, L'Oréal, and Warby Parker have pioneered this approach, with Sephora's Virtual Artist AR app recording over 8.5 million try-ons in its first year (Hapsari et al., 2023).

Spatial placement visualization constitutes another significant application category, particularly relevant for furniture, home décor, and large household items. Retailers like IKEA have developed AR applications enabling consumers to project virtual furniture into their actual living spaces, allowing assessment of size, style, and aesthetic compatibility before purchase (Garg et al., 2021). This capability addresses a major purchase barrier—uncertainty about whether products will fit appropriately in intended spaces.

Interactive product exploration through VR creates immersive shopping environments where consumers can navigate virtual stores, examine products from multiple angles, and access detailed information through intuitive interfaces (Vineet et al., 2021). These virtual environments can replicate physical store layouts or create entirely novel shopping experiences unconstrained by physical limitations.

Impact on Consumer Behavior and Purchase Decisions

Recent research demonstrates that AR and VR significantly influence multiple dimensions of consumer behavior. Media usefulness and media enjoyment, enhanced through highly interactive and vivid AR shopping platforms, substantially increase consumer engagement, subsequently leading to stronger purchase intentions (Bajpai & Islam, 2022). The realistic product experiences created by these technologies closely mimic physical shopping, thereby increasing consumer confidence in purchase decisions.

Studies indicate that AR characteristics are perceived by consumers as more utilitarian than hedonic, with stronger positive responses to utilitarian aspects that boost product promotion and understanding (Eru et al., 2022). However, the hedonic value—including novelty and enjoyment—also contributes significantly to overall consumer satisfaction and engagement with AR-enabled shopping experiences.

The influence on purchase intention is particularly noteworthy. Research reveals that consumers engaging with AR are significantly more likely to convert, with studies reporting conversion rate increases of up to 90% for AR users compared to non-AR users (Ebrahimi et al., 2024). This dramatic improvement stems from enhanced visualization capabilities that reduce uncertainty and increase confidence in product selection.

Reduction in Return Rates

One of the most economically significant impacts of AR and VR in e-commerce is the reduction in product return rates. Online shopping has

historically suffered from high return rates, with research indicating that 49% of UK online shoppers returned items purchased within the past year, rising to 60% for consumers aged 16-34 (Faour-Klingbeil et al., 2021). These returns represent substantial costs for retailers in terms of reverse logistics, restocking, and potential product depreciation.

AR and VR technologies address this challenge by enabling consumers to make more informed purchase decisions. When customers can accurately visualize how products will appear in their spaces or on their bodies, the alignment between expectations and reality improves dramatically. Studies report that retailers implementing AR for product visualization experience return rate reductions ranging from 25% to 40% (Morrison, 2021). Specific examples include Macy's reporting return rates dropping to under 2% for furniture visualized through AR, compared to 5-7% normally.

Current Market Trends and Adoption Patterns

The AR and VR market in retail is experiencing exponential growth. The global mobile augmented reality market reached \$11.9 billion in 2024 and is projected to grow to \$36 billion by 2026 (Statista, 2024). Consumer adoption has reached a tipping point, with nearly 60% of the U.S. population expected to be frequent AR users by 2025, and over 90% of American shoppers either using AR or open to using it for shopping purposes (BrandXR, 2025).

Demographic patterns reveal particularly strong adoption among younger consumers. Approximately 92% of Gen Z consumers express desire to use AR tools for e-commerce, viewing such features as essential rather than optional (Salsify, 2023). This generational preference is reshaping retail infrastructure requirements, as businesses recognize that failing to offer immersive experiences may result in competitive disadvantage, particularly in capturing younger market segments.

Major technology platforms have accelerated AR accessibility. Snapchat reports that over 300 million users engage with AR daily, comprising over two-thirds of its daily active users (Snapchat, 2024). Instagram, Facebook, and TikTok have similarly expanded AR offerings, creating a ready audience of hundreds of millions comfortable with AR interactions.

Methodology

Research Design

This study employs a comprehensive literature review methodology, synthesizing recent empirical research, industry reports, and case studies to examine the impact of AR and VR on online shopping experiences. The research adopts a qualitative approach supplemented by quantitative data from existing studies to provide a holistic understanding of the phenomenon.

Data Collection

Data were collected from multiple sources including:

Peer-reviewed academic journals published between 2021-2025, focusing on AR/VR applications

in e-commerce, consumer behavior, and digital marketing. Industry reports from market research firms including Statista, Gartner, Deloitte, and specialized AR/VR research organizations. Case studies and performance data from major retailers implementing AR and VR solutions are studied. Consumer survey data examining attitudes, preferences, and behaviors related to AR and VR shopping experiences is also considered for this research.

Data Analysis

The collected literature and data were analyzed thematically, identifying key patterns, trends, and findings related to consumer engagement and behavioral outcomes, purchase confidence and decision-making processes, conversion rates and return rate impacts, demographic variations in adoption and usage, implementation challenges and barriers and Business outcomes and return on investment. Similarly quantitative data from various studies were synthesized to identify consistent patterns and ranges of impact across different retail contexts and product categories.

Results and Discussion

Impact on Consumer Engagement

The evidence overwhelmingly demonstrates that AR and VR technologies substantially enhance consumer engagement in online shopping environments. The immersive and interactive nature of these technologies creates experiences that capture attention and sustain interest far more effectively than traditional product photography or video content.

Research indicates that AR engagement has increased by nearly 20% since early 2020, with conversion rates rising by 90% for consumers interacting with AR compared to those who do not (Reydar, 2024). This engagement translates directly into measurable business outcomes. Shopify's data reveals that products featuring 3D/AR content experience an average of 94% higher conversion rates than products without such features (Shopify, 2024).

The mechanisms underlying this enhanced engagement are multifaceted. First, AR and VR provide novelty and hedonic value—consumers find immersive experiences enjoyable and entertaining in their own right (Bajpai & Islam, 2022). Second, these technologies offer utilitarian benefits by providing more comprehensive product information and visualization capabilities than traditional formats. Third, the interactive nature of AR and VR creates a sense of control and personalization that consumer's value highly.

Specific case studies illustrate these patterns. Ulta Beauty generated \$6 million in sales from 30 million product try-ons in just two weeks through Snapchat AR integration (BrandXR, 2025). Gucci reported a 188% boost in product page views and 25% increase in purchase intent following AR implementation. These outcomes reflect not merely incremental improvements but transformative changes in how consumers interact with products online.

Enhancement of Purchase Confidence

A critical finding across multiple studies is that AR and VR significantly enhance purchase confidence by reducing uncertainty about product characteristics, fit, and suitability. This confidence boost operates through several mechanisms.

First, AR and VR enable more accurate assessment of product dimensions, proportions, and spatial relationships. When consumers can visualize furniture in their actual living spaces or see how clothing fits on their own body types, the guesswork inherent in traditional online shopping diminishes substantially (Galappaththi et al., 2024). Research indicates that 56% of consumers report that AR technology boosts their confidence in product quality (Forbes Councils, 2024).

Second, these technologies provide richer, more detailed product information through interactive exploration. Rather than viewing static images from predetermined angles, consumers can manipulate virtual products, examine them from multiple perspectives, and access contextual information dynamically (Garg et al., 2021). This comprehensive understanding naturally leads to greater confidence in purchase decisions.

Third, AR and VR reduce the psychological distance between online browsing and actual product ownership. By allowing consumers to virtually "try on" or "place" products, these technologies create a sense of provisional ownership that strengthens purchase intention and reduces pre-purchase anxiety (Eru et al., 2022).

The impact on purchase confidence is particularly pronounced for high-involvement purchases such as furniture, where consumers traditionally prefer in-store shopping due to concerns about size, style, and quality. AR applications have successfully addressed these concerns, with 71% of consumers indicating they would shop more frequently if AR experiences were available (NCBI, 2023).

Reduction in Product Returns

Perhaps the most economically significant impact of AR and VR implementation is the substantial reduction in product return rates. Returns represent a major cost center for e-commerce retailers, involving reverse logistics, restocking labor, potential product damage, and lost sales opportunities.

The data consistently demonstrates that AR and VR dramatically reduce returns by improving the alignment between consumer expectations and actual product characteristics. Shopify reports that merchants using AR for product visualization experience 40% fewer returns (Shopify, 2024). Similarly, retailers implementing AR for virtual fittings have seen return rate reductions of up to 25% (Morrison, 2021).

Specific examples provide compelling evidence. Macy's implementation of AR for furniture visualization resulted in return rates dropping to under 2%, compared to the typical 5-7% for furniture purchased without AR assistance (BrandXR, 2025). This reduction represents substantial cost savings—for a retailer with \$50 million in annual furniture sales, reducing returns from 6% to 2% would save

approximately \$2 million annually in return-related costs.

The mechanisms driving return reduction are straightforward: when consumers can accurately visualize products before purchase, they make better-informed decisions about suitability, fit, and aesthetic compatibility. The common reasons for returns—wrong size, doesn't match expectations, doesn't fit the space—are directly addressed by AR and VR visualization capabilities.

This return reduction benefits consumers as well as retailers. Consumers avoid the inconvenience of initiating returns, repackaging products, and waiting for refunds. The improved match between expectations and reality enhances satisfaction and builds trust in the retailer (Hapsari et al., 2023).

Conversion Rate Improvements

Beyond engagement and return reduction, AR and VR demonstrate remarkable impacts on conversion rates—the percentage of shoppers who complete purchases. This metric directly influences revenue and represents a key performance indicator for e-commerce operations.

Research consistently shows dramatic conversion improvements associated with AR and VR implementation. Studies report conversion rate increases ranging from 25% to 94% for products with AR/VR features compared to those without (Shopify, 2024; Reydar, 2024). IKEA Place, for example, achieved a 189% conversion rate increase for AR-enabled furniture (BrandXR, 2025).

These improvements stem from multiple factors. First, enhanced visualization and confidence naturally lead more browsers to become buyers. When uncertainty decreases, purchase hesitation diminishes proportionally. Second, the engaging nature of AR and VR experiences keeps consumers on product pages longer, increasing the likelihood of conversion. Third, the novelty and enjoyment of immersive experiences create positive emotional associations with products and brands, facilitating purchase decisions (Bajpai & Islam, 2022).

Retailers using AR report an average 25% uplift in conversions and 35% reduction in returns, while 61% of consumers prefer to shop with brands offering AR experiences (Medium, 2025). These preferences translate directly into competitive advantage, as consumers increasingly choose retailers offering immersive experiences over those maintaining traditional formats.

The integration of AR has been shown to increase consumer purchase intention by 17% (AMA, 2024), with 71% of shoppers indicating they would shop more frequently with AR access. Furthermore, 40% of consumers express willingness to pay premium prices for products they can experience through AR (SCAYLE, 2025).

Demographic Variations

Analysis reveals significant demographic variations in AR and VR adoption and preferences. Younger consumers, particularly Gen Z and Millennials, demonstrate substantially higher adoption

rates and more positive attitudes toward immersive shopping technologies.

Approximately 92% of Gen Z consumers want to use AR tools for e-commerce, viewing such capabilities as essential rather than optional features (Salsify, 2023). This cohort has grown up with smartphones and interactive digital experiences, making AR feel natural rather than novel. Gen Z consumers are more inclined to purchase products if they can experience them through AR first, and they find AR ads more personal and attention-grabbing than traditional formats (BrandXR, 2025).

The preference gap between younger and older consumers is substantial. While 71% of overall consumers prefer retailers offering AR experiences, this percentage rises significantly among those under 35. The 16-34 age group also demonstrates higher return rates when AR is not available—60% compared to 49% overall—suggesting that younger consumers particularly benefit from enhanced visualization capabilities (Mintel, 2024).

These demographic patterns have important strategic implications. As Gen Z's purchasing power grows, retailers failing to implement AR and VR risk losing relevance with this crucial demographic segment. The technologies that seem optional for reaching older consumers become essential for capturing younger markets.

Geographic variations also exist, with higher adoption rates in technologically advanced markets and urban areas where smartphone penetration and internet connectivity support AR experiences. However, the gap is narrowing as mobile technology becomes increasingly accessible globally.

Implementation Challenges and Barriers

Despite the compelling benefits, AR and VR implementation in e-commerce faces several significant challenges that retailers must address.

Technological Limitations: Hardware constraints represent a persistent bottleneck. Mobile and head-worn devices must simultaneously process real-time tracking, computer vision, and 3D rendering, which strains processors and accelerates battery drain (Sahu et al., 2025). Latency-related issues such as jitter, lag, and motion-to-photon delays break immersion and can contribute to cybersickness, undermining sustained engagement (Parekh et al., 2020).

Cost Considerations: High-end AR and VR devices often require specialized GPUs, headsets, and external sensors, making large-scale deployments financially prohibitive for some retailers (Alnuaimi, 2025). While smartphone-based AR is more accessible, creating high-quality 3D models and AR experiences requires significant investment in content creation, including 3D modeling, photogrammetry, and specialized photography. Many retailers lack in-house expertise for these technical processes.

Integration Complexity: Incorporating AR and VR into existing e-commerce platforms, inventory systems, and customer relationship management tools can be technically complex. Ensuring seamless experiences across different devices, operating

systems, and browsers requires substantial development effort (MarketsandMarkets, 2024).

Consumer Awareness and Comfort: While adoption is growing, some consumers remain unfamiliar with AR and VR features or hesitant to use them. Retailers must invest in user education and interface design that makes these technologies intuitive and accessible to users with varying technical comfort levels.

Privacy Concerns: AR and VR applications often require access to device cameras, location data, and potentially biometric information for features like virtual try-ons. These privacy considerations create potential barriers for privacy-conscious consumers and regulatory compliance challenges for retailers (Bouderhem, 2024).

Industry-Specific Applications

The impact and implementation of AR and VR vary across different retail sectors, with some industries demonstrating particularly strong adoption and results.

Fashion and Apparel: Virtual try-on solutions have become increasingly sophisticated, with brands enabling consumers to see how clothing, shoes, and accessories appear on their own bodies. Companies like Nike and Tommy Hilfiger have successfully implemented AR features, with Tommy Hilfiger's AR mirrors increasing in-store try-ons and foot traffic by up to 60% (BrandXR, 2025).

Beauty and Cosmetics: This sector has emerged as an early adopter, with brands like Sephora, L'Oréal, and MAC Cosmetics using AR to allow virtual makeup application and skin tone analysis. These applications enhance customer experience through personalized recommendations based on facial recognition and provide tailored advice that improves customer loyalty (MarketsandMarkets, 2024).

Furniture and Home Décor: Spatial placement visualization is particularly valuable for furniture retailers. IKEA's AR application allows consumers to see exactly how furniture will look and fit in their spaces, addressing major purchase barriers around size and style compatibility. The effectiveness is reflected in dramatic conversion improvements and return reductions (Garg et al., 2021).

Eyewear: Companies like Warby Parker have successfully implemented AR virtual try-ons for glasses and sunglasses, significantly reducing return rates by allowing consumers to assess fit and appearance before purchase (Morrison, 2021).

Implications and Recommendations

Strategic Implications for Retailers

The evidence presented suggests that AR and VR are transitioning from optional innovations to essential components of competitive e-commerce strategy. As 80% of major retailers deploy AR by 2025 (Gartner, 2024), the technology shifts from competitive advantage to market requirement. Retailers not implementing immersive experiences risk falling behind competitors and losing market share, particularly among younger demographics.

The business case for AR and VR investment is compelling. With conversion rate improvements of 25-94%, return reductions of 25-40%, and demonstrated consumer preferences for retailers

offering these experiences, the return on investment can be substantial. For mid-size retailers, even modest improvements in these metrics can generate millions in additional revenue while reducing operational costs associated with returns.

Implementation Recommendations

Based on the findings, retailers should consider the following strategic approaches:

1. **Start with High-Impact Applications:** Focus initial AR and VR investments on product categories where visualization challenges are greatest—furniture, apparel, cosmetics, and other items where fit, size, or appearance uncertainty drives returns and purchase hesitation.
2. **Prioritize Mobile-Based AR:** Given smartphone ubiquity and the technical challenges of dedicated AR/VR hardware, mobile-based AR solutions offer the most accessible entry point for both retailers and consumers. Web AR technologies that function through browsers without requiring app downloads reduce adoption friction.
3. **Invest in Quality Content Creation:** The effectiveness of AR experiences depends heavily on accurate, high-quality 3D models and visualization. Retailers should invest in professional 3D modelling, photogrammetry, and content creation capabilities or partner with specialized providers.
4. **Design for Intuitive User Experience:** AR and VR features must be immediately intuitive to users with varying technical comfort levels. Clear instructions, simple interfaces, and seamless integration into existing shopping flows are essential for maximizing adoption.
5. **Address Privacy Transparently:** Clearly communicate what data AR and VR features collect, how it will be used, and what privacy protections are in place. Transparency builds trust and reduces adoption barriers among privacy-conscious consumers.
6. **Measure and Optimize:** Implement robust analytics to track AR and VR engagement, conversion impacts, and return rate changes. Use this data to continuously optimize experiences and demonstrate ROI to stakeholders.
7. **Consider Omni channel Integration:** AR and VR should enhance both online and physical retail experiences. In-store AR mirrors, navigation systems, and product information overlays can revitalize brick-and-mortar locations while creating consistent experiences across channels.

Future Research Directions

While this study provides comprehensive insights into AR and VR's current impact on online shopping, several areas warrant further investigation. First, longitudinal research examining the long-term effects of AR and VR adoption on brand loyalty and customer lifetime value would offer valuable insights into sustained consumer engagement patterns. Second, empirical studies exploring optimal design principles for AR and VR shopping experiences across diverse product categories could establish evidence-based

guidelines for practitioners. Third, the integration of artificial intelligence in enhancing AR and VR personalization presents a promising avenue for investigation, particularly regarding adaptive user interfaces and predictive recommendation systems. Fourth, comparative effectiveness studies evaluating different AR and VR implementation approaches would help organizations determine optimal deployment strategies. Fifth, cross-cultural research examining variations in AR and VR adoption rates and user preferences across different geographical and demographic contexts remains underexplored. Finally, investigating the impact of emerging technologies such as 5G connectivity, edge computing, and haptic feedback systems on AR and VR shopping experiences would provide critical insights into next-generation immersive retail environments. These research directions collectively address theoretical gaps while offering practical implications for stakeholders seeking to leverage immersive technologies in digital commerce contexts.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper

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